Surgical Management of Upper Gastrointestinal Bleeding

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KEYWORDS

• Upper GI bleeding • Portal hypertension • General surgery • Peptic ulcer disease • Hemostasis • Vagotomy • Portosystemic shunt

KEY POINTS

- Surgical management of upper gastrointestinal (GI) bleeding is increasingly rare given advances in endoscopy and interventional radiology technologies.
- Surgical management of peptic ulcer disease involves denervation of the acid-secreting cells, which also affects stomach drainage and GI motility.
- Portosystemic shunt surgery has largely been replaced by transjugular intrahepatic portosystemic shunt (TIPS) procedures, but the superiority of TIPS over shunt surgery has yet to be definitively demonstrated.
- Surgeries used to treat the underlying causes of upper GI bleeding can have long-term sequelae and syndromes with which both surgeons and gastroenterologists should be familiar.

INTRODUCTION

Endoscopic management for patients with acute upper gastrointestinal (GI) bleeding has been the standard of care since the early 1990s.[1] Advancement in endoscopic technology, instrumentation, and technical skill, as well as the discovery of proton-pump inhibitors (PPI) and Helicobacter pylori infection as the etiology of most peptic ulcers, has made once-common surgeries for GI bleeding a rare event. Today, only 2% to 8% of patients with upper GI bleeding are managed surgically, though open surgical intervention remains common internationally in areas without advanced endoscopy or interventional radiology.[2]

Approximately 80% of all gastrointestinal bleeding originates in the upper GI tract, defined as the esophagus, stomach, and duodenum to the Ligament of Treitz.[2]

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Common practice dictates that a patient with an acute upper GI bleed should be resuscitated and undergo an endoscopy with possible intervention within 24 hours of admission.[3] If bleeding recurs, either a repeat endoscopy, angioembolization, or surgery should be considered.[4] Incidence of recurrent bleeding after endoscopy ranges from 11% to 33%.[2,5,6] Incidence of recurrent bleeding after angioembolization is similar, ranging from 10% to 20%.[2] Surgery is rarely needed for management of acute upper GI bleeding. A 2012 study looking at the use of surgery or angioembolization after failed endoscopic management for upper GI bleeding in 4478 patients found that only 533 patients experienced rebleeding (11.9%), with 163 of these patients requiring surgery, 60 angioembolization, and 6 undergoing both interventions.[7] Mortality was equivalent between patients with recurrent GI bleeding undergoing repeat endoscopy (23%), angioembolization (23%) and surgery (29%).[7]

While the majority of patients can be stabilized with endoscopy alone, management of acute upper GI bleed requires a collaborative, multidisciplinary approach between gastroenterologists, radiologists, and surgeons. Although the need for surgical intervention is rare, surgical management of acute upper GI bleed remains an essential skill of the general surgeon. Knowing when to do surgery, and what surgery to do, for both hemostasis and disease treatment, is important. Furthermore, surgery for upper GI bleeding can alter anatomy and lead to unique postoperative syndromes that require long-term management by a surgeon and/or gastroenterologist.

PEPTIC ULCER DISEASE

Gastric Ulcer

Peptic ulcer disease (PUD) is the most common cause of upper GI bleeding, representing 40% of all cases.[2] Before advances in endoscopic and interventional radiology (IR) technology in the early 1990s, surgery was the mainstay of treatment for patients with PUD. Now, only 4.3% of patients with upper GI bleeding due to peptic ulcer disease require surgical management.[8] Surgery should be considered for patients who are hemodynamically unstable secondary to hemorrhage or continue to bleed despite multiple endoscopic and/or IR interventions. Additionally, early surgical consultation should be considered for patients with a high risk of rebleeding based on the Forrest Classification, ulcers greater than 2 cm in size, and ulcers located in the stomach or posterior duodenum; patients with these ulcer characteristics are more likely to require surgery for recurrent or refractory bleeding.[2] Although simultaneous peptic ulcer bleeding and perforation is unusual, this situation also requires surgical intervention.[5] Particularly in elderly and medically frail populations, using endoscopy or interventional radiology approaches and avoiding major abdominal surgery is an advantage.[9]

There are 2 basic methods by which a bleeding peptic ulcer can be managed: oversewing or resection. Oversewing involves making an intentional gastrotomy in the anterior aspect of the stomach in order to visualize the gastric lumen, identifying the bleeding ulcer, and using sutures to ligate vessels and achieve hemostasis. Oversewing is helpful if an ulcer is present in an area of the stomach where resection is difficult. It is essential that the surgeon biopsy a stomach ulcer when oversewing, as 6% of gastric ulcers will be malignant.[2] Oversewing addresses the acute problem—hemorrhage—but does not address the underlying cause of the ulcer. Since medical therapy for peptic ulcer disease has become routine, it is unusual to perform acid-reducing and resection procedures, such as vagotomy and antrectomy (**Table 1**), which were commonly performed in the past.

After oversewing, continued histamine H2-receptor antagonist (H2 blocker) but preferably PPI therapy is necessary in the postoperative period to reduce acid and assist in

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Table 1
Types of acid-reducing procedures

	Definition	Advantages	Disadvantages
Truncal Vagotomy	Transection of the right and left vagus nerves at or above the level of the diaphragmatic hiatus. Must send 2 cm of each nerve for pathologic confirmation. Disrupts the acid-secreting parietal cells, and slows stomach emptying.	Decreases acid secretion by 60%–70%.	Drainage procedure required due to denervation of pylorus. Dumping syndrome. Diarrhea.
Highly Selective Vagotomy	Division of the vagus nerve branches 7 cm proximal to the pylorus and 6 cm from the distal esophagus. Goal is disruption of branches that innervate parietal cells only.	Minimize motility and drainage issues that result from a truncal vagotomy.	Highest risk of ulcer recurrence.
Gastric Antrectomy	Resection of the gastric antrum, pylorus, and first portion of duodenum to remove the gastrin-secreting cells, which also stimulate HCl secretion.	When combined with vagotomy, reduces acid secretion up to 85%.	Requires reconstruction to restore foregut continuity.

ulcer healing. Repeat endoscopy should be performed in 8 to 12 weeks after surgery for a bleeding gastric ulcer to document ulcer healing. If biopsies were not performed at the time of surgery, these should be done at interval endoscopy in order to rule out malignancy. If the ulcer is refractory and not healing, risk factor evaluation including smoking, alcohol, non-steroidal anti-inflammatory drug (NSAID) use, gastrinomas, Helicobacter pylori infection, and non-adherence to medications should be investigated.[10]

Surgical resection of a peptic ulcer is more involved, both in terms of surgical decision-making and technical nature of the surgery. Typically, surgeons will build an operative plan by answering the following questions.

1. Does the bleeding peptic ulcer need resection back to healthy tissue (due to perforation or tissue ischemia)?
2. Does the patient need an acid-reducing procedure to prevent future ulcers (see **Table 1**)?
3. How will one drain and reconstruct the foregut following a resection (**Figs. 1** and **2**, **Table 2**)?

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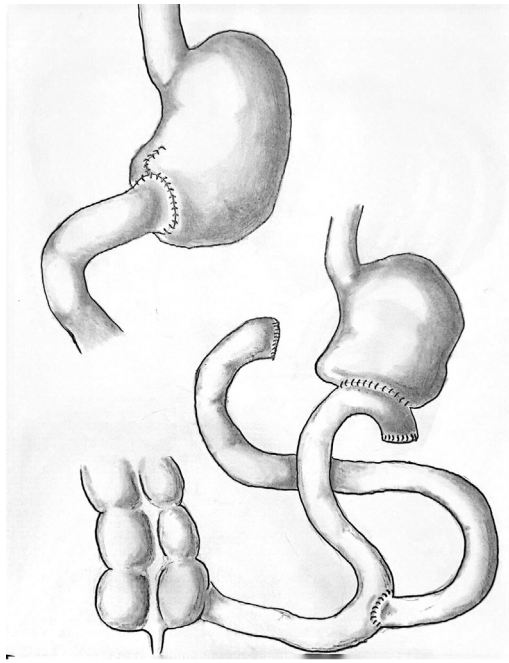

Fig. 1. Billroth I anatomy is depicted in the illustration in the upper left-hand corner. Billroth I reconstruction involves gastric antrectomy and restoration of gastrointestinal (GI) continuity with an anastomosis between the remaining portion of the stomach and the duodenum. Roux-en-Y gastric bypass anatomy is depicted in the illustration in the lower right-hand corner. After antrectomy, GI continuity is restored by creating a gastrojejunostomy (Roux limb or efferent limb). The duodeno-biliopancreatic limb (afferent limb) joins the efferent limb with an anastomosis of small bowel to small bowel. The small intestine distal to this anastomosis is called the common channel.

In the acute setting, surgical resections are more often employed to treat perforation with destruction of the tissues or gastric outlet obstruction secondary to PUD. These surgeries are less likely to be employed to control hemorrhage. In fact, given the high success of medical management, it is atypical to see the use of acid-reducing and drainage procedures unless maximal medical therapy has already been tried and failed.[11]

In addition to addressing upper GI bleeding, acid-reducing and resection procedures can be indicated in the semi-elective setting for patients who have refractory ulcers and cannot modify risk factors such as patients allergic to PPIs, patients with arthritis and require NSAID use for symptom management, and those who have persistent H pylori infections despite treatment. If indicated, the surgeon must determine what kind of acid-reducing and drainage procedure is needed for the patient based on the patient's disease process and desire to avoid chronic side effects. Furthermore, a bleeding ulcer may represent gastric malignancy, so a surgeon must consider what impact resection will have on future oncologic margins and outcomes.

Surgeons who trained in recent decades have limited exposure to acid-reducing and drainage operations. This lack of experience, combined with the fact that the patients nowadays who undergo these procedures have refractory PUD, may very well contribute to poor clinical outcomes despite other advances in general hospital and

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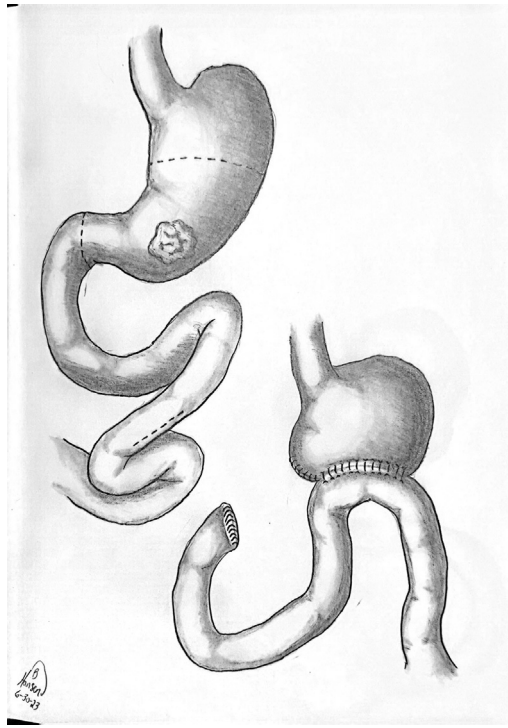

Fig. 2. Illustration depicts a stomach with ulcer pathology and subsequent Billroth II reconstruction after partial gastric resection. The Billroth II differs from the Billroth I in that there is no gastroduodenal anastomosis; a loop of proximal jejunum is instead connected to the remainder of the stomach to restore intestinal continuity.

perioperative care. A recent retrospective review of complications across 2007 to 2015 at a single center showed a high mortality at 20% (highest in the elderly and those presenting with hemorrhage) and noted that readmissions and reoperations are not uncommon.[12]

Duodenal Ulcer

Duodenal ulcers can be treated with oversewing or resection in a similar manner to surgical management of gastric ulcers. Unlike gastric ulcers, duodenal ulcers are rarely malignant, do not require routine endoscopic surveillance for healing, and nearly all are caused by H pylori infection.[13] Unique to duodenal ulcers, however, is the possibility of life-threatening hemorrhage from ulcer erosion of the gastroduodenal artery, located at the posterior aspect of the first portion of duodenum. Posterior location of a duodenal ulcer is a risk factor for failed endoscopy therapy compared to those located anteriorly.[6] Indeed, in a study reviewing the ulcer location of patients requiring emergency surgery for upper GI bleed, 72% of the patients had ulcers located in the posterior duodenal wall.[6]

Today, with PPI therapy and H pylori treatment, vagotomy and drainage procedure is rarely necessary for duodenal ulcers.[2] Thus, oversewing a bleeding posterior duodenal ulcer is commonly taught and tested surgical knowledge. The retroperitoneal duodenum is mobilized via a "Kocher maneuver" and a generous longitudinal incision along the pylorus and first portion of the duodenum provides access to the

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Table 2
Types of drainage/reconstructive procedures

	Surgical Description	Advantages	Disadvantages
Pyloroplasty (Heineke-Mikulicz, Finney, Jaboulay)	Transverse closure of a longitudinal incision along the pylorus.	Widens pylorus to assist in gastric emptying.	Does not include resection of antrum, which may result in additional acid secretion.
Billroth I	Antrectomy + gastro-duodenostomy reconstruction.	Addresses residual acid secretion.	Diarrhea. Dumping syndrome. Alkaline reflux gastritis.
Billroth II	Antrectomy + loop gastrojejunostomy reconstruction.	Addresses residual acid secretion. Lower anastomotic tension.	Diarrhea. Dumping syndrome. Alkaline reflux gastritis. Risk of duodenal stump blowout.
Roux-en-Y	Antrectomy + Roux-en-Y gastrojejunostomy and jejunojejunostomy reconstruction.	Addresses residual acid secretion. Reduces alkaline reflux.	Marginal ulcer. Internal hernia.

posterior wall of the duodenum. Ligation of the gastroduodenal artery is performed by placing a suture at the anterior, posterior, and lateral aspects of the ulcer to ligate the artery and its branches. Care is taken when placing a suture laterally, as the common bile duct is below the duodenum in this region and can be injured with ligation. The incision along the pylorus is closed transversely so as not to narrow the pyloric channel and cause obstruction.

SURGICAL MANAGEMENT OF PORTAL HYPERTENSION AND ACUTE VARICEAL BLEEDING

Though there are several different etiologies of portal hypertension, and therefore varied strategies of optimization, medical management is the ideal approach in order to control the development of gastric and/or esophageal varices (primary prophylaxis). Acute bleeding requires both rapid control of the bleeding source and, frequently, shunting procedures are performed to decrease the degree of portal hypertension and thereby diminish rebleeding risk (secondary prophylaxis). Approaches to shunting include interventional radiology,transjugular intrahepatic portosystemic shunt (TIPS), or portosystemic shunt surgery (PSSS) which has several variations. Just as surgical management of PUD is now rare given advances in medication and endoscopic treatment of PUD, the use of surgical shunts for management of portal hypertension is increasingly rare in high-income countries.

In current practice, gastric varices are commonly managed with endoscopic therapy of bleeding varices, and subsequent maximal medical therapy to decrease portal hypertension which may necessitate portosystemic shunting. The surgical alternative is to perform a gastrotomy and ligate the bleeding varices directly, which should be followed by some form of shunting to decrease underlying portal hypertension.[14] Patients with bleeding esophageal varices who have failed endoscopic intervention,

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should have a Sengstaken–Blakemore tube placed to tamponade the bleeding for several hours to allow for aggressive resuscitation prior to any surgical or interventional radiology intervention. This converts an emergent surgery into a semi-urgent surgery, which in turn can improve patient outcomes given time for resuscitation.[14] Surgical shunting is relatively well tolerated with 1 study reporting a specific surgical approach (distal splenorenal shunt, described in a table later) resulting in a 6% perioperative mortality (within a literature supported 0%–14% and lower than the TIPS comparison of 7%–45%) and an 85% 1-year survival.[15]

TIPS rapidly replaced surgical shunt procedures due to the ease of placement, avoidance of a major abdominal surgery for the patient, and reduction in cost and length of hospitalization. However, use of TIPS became widespread before data demonstrated its superiority over PSSS.[16] At the beginning of their clinical use, the upfront benefits of TIPS compared to surgery were compromised by the use of bare-metal stents, which had an 80% in-stent thrombosis rate at 2 years and required routine surveillance to monitor for these types of complications.[17] Studies at the time showed perioperative survival to be equivalent between TIPS with bare-metal stents and distal spleno-renal shunt surgery resulting in a practice favoring TIPS due to ease of insertion albeit the need for frequent re-intervention and surveillance.[18] However, introduction of polytetrafluoroethylene (PTFE)-covered stents has resulted in improved stent patency, decreased rates of encephalopathy, and decreased mortality.[17] It is therefore important to note that there is limited literature to compare PSSS to TIPS with PTFE stents, given the ubiquity of TIPS and waning surgical expertise in shunt procedures in high-income countries.

Keeping this in mind while evaluating available literature, our meta-analyses include data from bare-metal and PTFE-stent papers. Multiple Cochrane Reviews on portosystemic surgical shunts (PSSS) suggest the superiority of surgery over TIPS with low-certainty,[19] offered no recommendation on surgery versus endoscopic intervention,[20] and gave no recommendation on shunts versus devascularization procedures.[21] Another Cochrane review has a submitted protocol on selective versus nonselective shunts (discussed later) and including TIPS of varying diameter, which has not been published.[22] In conclusion, there are no strong data for or against one type of intervention to hold sway over the others.

The use of PSSS should be reconsidered despite the ease and ubiquity of TIPS. A 2010 meta-analysis found similar morbidity and mortality at 30-days and 1-year follow-up, but significantly improved 2-year mortality and decreased shunt failure with PSSS over TIPS.[23] A 2009 randomized control trial called into question the current low rate of surgical shunting nationwide, suggesting that surgery is superior to TIPS for permanent bleeding control, transfusion need, and survival at all time intervals and with all Child's classes.[24] These studies indicate that surgical shunting should not be abandoned and may merit updated research and re-evaluation.

Based on consensus guidelines, indications to consider surgical shunts (in centers where expertise exists) are similar to that of TIPS: prevention of recurrent variceal hemorrhage (secondary prophylaxis) and acute variceal bleeding which has failed endoscopic intervention.[25,26] Specifically, under consideration are patients with advanced cirrhosis already complicated by encephalopathy (who are not candidates for TIPS), patients with variceal bleeding and well-compensated cirrhosis not nearing transplant, or patients with portal hypertension due to extra-hepatic veno-occlusive disease, who may be appropriate candidates for surgical shunt procedures.[19,27,28]

There are several surgical options to address the different needs of a patient with portal hypertension which can be grouped into 3 categories based on the patient's needs.

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1. Esophagogastric devascularization ± splenectomy ± transection & reanastomosis

Usually used in extreme cases to prevent further variceal rebleeding. Devascularization procedures could also play a role in preventing a primary bleeding in select cases, particularly for patients who reside physically far from medical access points.[14]

2. Porto-systemic surgical shunts (PSSS) (**Figs. 3** and **4**, **Table 3**):

Nonselective shunts, preferred for greater control of variceal bleeding, work by offloading a greater volume of blood through the shunt. Unfortunately, this causes them to also be associated with higher immediate postoperative encephalopathy and greater deterioration of liver function, yet without notable difference in mortality. Interestingly, there is no appreciable difference in long-term survival, encephalopathy, and bleeding between the selective and nonselective types, likely due to a loss of selectivity over time.[29]

3. Orthotopic liver transplantation: As the only curative option to refractory/recurrent variceal bleeding and its associated underlying liver disease, shunting procedures (including TIPS) are often considered a logical "bridge to transplant." Yet, only 3% to 14% of patients with TIPS go on to transplant.[19] If surgical shunting is warranted prior to transplantation, surgeons often prefer H-graft or splenorenal shunt surgery to minimize portal dissection in a future surgical field.[14,15] The complex patient selection and several variations in the surgical techniques in liver transplantation are beyond the scope of this article.

The selection of surgical shunt or devascularization is highly dependent on the etiology of the patient's portal hypertension, vascular anatomy, and transplant prospects in the future. No standardized algorithm exists due to the complex interplay between the afore mentionede considerations, and careful planning is necessary to decrease portal venous pressure without risking encephalopathy by offloading too much volume through the shunt. This anatomy-dependent choice may be aided in the modern age by the assistance of radiologists and advanced imaging.[30]

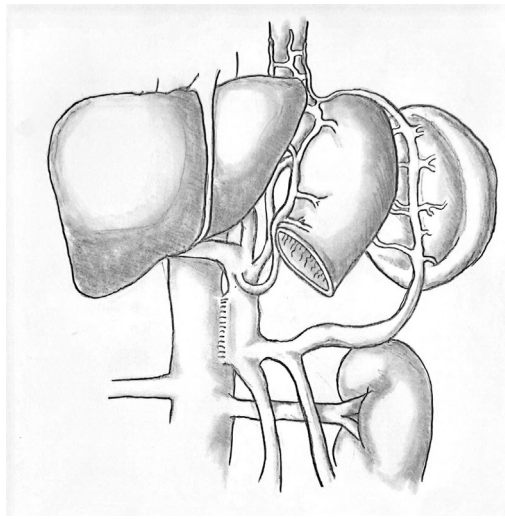

Fig. 3. Illustration of a side-to-side porto-caval shunt. The portal vein is sewn to the inferior vena cava in an attempt to divert portal blood flow into the systemic venous circulation to decrease portal hypertension.

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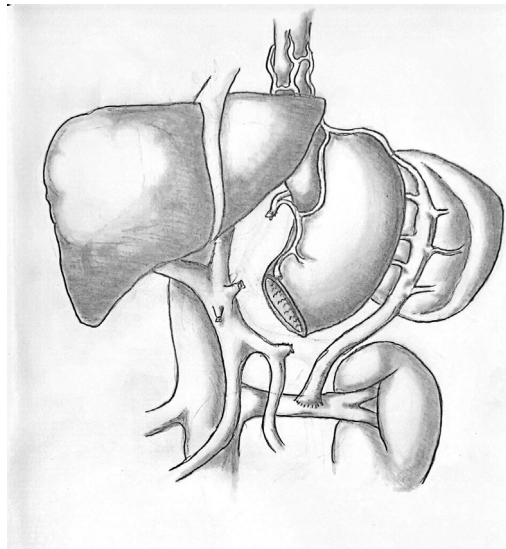

Fig. 4. Illustration of a spleno-renal shunt, where the ligation of the gastric and pancreatic veins lowers portal blood flow and decreases portal hypertension. The splenic vein is attached to the left renal vein to maintain venous outflow into the inferior vena cava.

Ultimately, perioperative morbidity and mortality from shunt procedures are primarily due to the residual hepatic function and resuscitation status of the patient at the time of surgery, and not the type of surgery that is performed. In patients with early/well-compensated cirrhosis not nearing transplant, or patients with

Table 3
Types of portosystemic shunts

	Concept	Illustrated Example	Additional Examples:
Nonselective Shunts	Divert portal and mesenteric blood flow into the IVC. Requires delicate balance of shunting and also maintaining transhepatic pressure gradient, ensuring residual portal venous flow.	Side-to-side portacaval shunt: inferior vena cava (IVC) and portal vein (PV) are isolated and mobilized to create a side-to-side PV-IVC anastomosis.	Mesocaval shunt, Interposition 16 mm H graft, Proximal spleno-renal shunt, Side-to-side splenorenal shunt.
Selective Shunts	Exploit dilated variceal anatomy to divert blood flow to more resistant venous flow, lowering portal venous pressure. Short-term advantages include maintenance of portal venous flow and less liver function derangement.	Distal spleno-renal shunt (DSRS): Ligation of the gastric and pancreatic veins lowers drainage into the portal vein. Distal splenic vein is mobilized to create an end-to-side anastomosis with the left renal vein.	Interposition 8 mm H-graft, Coronary-caval shunt ("coronary" referring to the left gastric vein)

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veno-occlusive disease (eg, Budd–Chiari or portal vein thrombosis), surgery still offers benefits.[14,27,28] In early cirrhosis, shunt surgery may prevent rebleeding events while offering a durable long-term patency with lower costs and health care usage.[14,15]

In conclusion, there remains controversy about the role of surgery in the management of portal hypertension, but it is undeniably less common for surgeons to have extensive shunting experience in the modern era of TIPS and advanced endoscopy. Therefore, the surgical options for any patient will be fundamentally influenced by the expertise available at your center of practice. It is important, however, to keep an open mind before relegating PSSS to historical status.

OTHER SOURCES OF UPPER GASTROINTESTINAL BLEED

Mallory–Weiss Tear

A Mallory–Weiss tear is a mucosal laceration, typically at the junction between the esophagus and stomach, that occurs secondary to forceful coughing, vomiting, or retching. While these tears are known to cause upper GI bleeding, they are typically self-limited. Only 10% of patients require intervention and rebleeding after intervention is even more unusual, occurring in 7% of patients.[2] Endoscopic management with clips or epinephrine injection is the first step in management. Recurrent bleeding should be addressed with either repeat endoscopy or angiography.[2] The morbidity of the open thoracotomy needed to access the lower esophagus, and the potential for esophageal leak, makes surgical management unfavorable in all but the most severe of circumstances.

Hemobilia

Hemobilia occurs due to a fistulous connection between the hepatic blood vessels and the bile ducts. It is a rare cause of GI bleeding. Causes of hemobilia include traumatic liver injury, hepatobiliary intervention (such as liver biopsy, endoscopic retrograde cholangiopancreatography (ERCP), or percutaneous transhepatic cholangiography), vascular malformations, inflammatory processes resulting in pseudoaneurysm, and malignancy.[31] While endoscopy can be performed to confirm diagnosis of hemobilia—with blood or clot seen emerging from the ampulla of Vater—it is not a therapeutic modality.[31] Computed tomography (CT) angiography can be used to localize a site of bleeding.

Hemobilia can often be managed with conservative and supportive treatment. If intervention is needed, preferred therapy would be angiography and embolization, vascular stenting, and thrombin injection.[2,31] Surgery is much more invasive, usually requiring resection of the segment or lobe in order to gain control of the vascular pedicle. While surgery carries a 90% success rate for hemorrhage control, it also is burdened by a high mortality rate (10%).[31]

Cameron Ulcer

Cameron ulcers are linear ulcers or erosions resulting from an ischemic insult to the folds of gastric mucosa due to a paraesophageal hernia; they are seen in 3% to 5% of hiatal hernia patients. Patients with Cameron ulcers present with chronic anemia, and up to 80% of Cameron lesions are missed on initial endoscopy. If presenting as an acute gastrointestinal bleed, these are usually controlled with endoscopic means. If Cameron ulcers are implicated in chronic gastrointestinal bleeding, there is strong evidence to suggest the superiority of hiatal hernia repair over medical management.[32]

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Dieulafoy Lesions

Dieulafoy lesions are dilated submucosal arteries in the stomach that can erode through the mucosa and cause upper GI bleeding. They are rare sources of bleeding, and endoscopic and IR angio-embolization are the ideal therapy for their success in hemostasis and minimally-invasive technique.[2]

Aortoenteric Fistula

Aortoenteric fistulas can occur after abdominal aortic aneurysm (AAA) repair. Aortoenteric fistula is rare, and can occur in patients who have undergone either an open AAA repair or an endovascular repair (EVAR). The classic presentation is one of a "herald bleed" that is often minor, followed later by massive exsanguination. Frustratingly, these fistulas can form at any time—early in the postoperative period, or years to decades after surgery. Because the fistula typically forms in the third-fourthth portion of the duodenum, endoscopic management is challenging and is not the standard of care. Esophagogastroduodenoscopy (EGD) also has low diagnostic sensitivity, approaching only 50%.[33] Thus, CTangiography (CTA) is recommended for diagnosis in a stable patient. If the CTA is negative for fistula, then EGD and colonoscopy should be performed to seek an alternative source of GI bleed. In an unstable patient with GI bleed and history of AAA, operative exploration in an open fashion or endovascular method is appropriate.[33]

UNIDENTIFIED GASTROINTESTINAL BLEEDING IN THE UNSTABLE PATIENT

Due to the evolution of contrast-enhanced radiography and evolving endoscopy techniques (capsule, double-balloon enteroscopy), intraoperative endoscopy is no longer recommended as first-line treatment for obscure gastrointestinal bleeding. It may still be indicated for adjunctive use during planned surgical intervention, and can be useful for identifying a mass or lesion that cannot otherwise be palpated by the surgeon in the operating room.[34] The surgeon can make a controlled enterotomy and introduce a port or the scope itself, guiding the advancement of the scope whilst the gastroenterologist controls insufflation and deflection. Without any tattoo or serosal findings to guide the surgeon, intraoperative enteroscopy is critical for localization of culprit lesions or confirming the absence of such lesions and avoiding unnecessary resection.[35]

In cases of exsanguinating hemorrhage with negative upper endoscopy and with suspicion for lower GI bleeding, the classic surgical teaching is to perform a total colectomy. This approach has not necessarily incorporated the advances in endoscopy and IR in the recent decades, and also fails to address small bowel sources. Most patients would instead have a multi-disciplinary collaboration to attempt to locate the bleed with intraoperative enteroscopy or on-table angiography during exploratory laparotomy.

In the rare cases of exsanguinating hemorrhage in which the patient is unstable for exclusively endoscopic or radiographic intervention, surgical intervention may be required to gain vascular control and resuscitation before truly identifying the source of bleeding. These events are more likely to occur with aorto-enteric fistula (discussed earlier) or duodenal ulcer erosion into the gastroduodenal artery (GDA) (discussed earlier). In these cases, the surgeon begins an exploratory laparotomy by first gaining control (vascular clamping) of the celiac and superior mesenteric artery (SMA) axes, allowing the anesthesia team to catch up with resuscitation. Once ready, the surgeon can employ endoscopy (upper, lower, or through an enterotomy as discussed earlier) to localize the lesion for resection. Additionally, centers with available IR could attempt

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on-table angiography to accomplish the same. Without a target, the surgeons cannot necessarily see any evidence to localize and resect a bleeding lesion, as the area of bleeding is often not apparent from the extra-luminal vantage point of the peritoneum. Without any ability to localize, surgeons can intraoperatively isolate segments of the gastrointestinal tract with sequential bowel clamping and controlled enterotomies for intraluminal investigation in order to localize the bleeding source for resection. No data or algorithms currently exist for this method given the rarity of the case and the high mortality of patients in such extremis.

LONG-TERM COMPLICATIONS AFTER MAJOR FOREGUT SURGERY

Any procedure which alters the drainage of the stomach carries long-term sequelae. Given how rare it is nowadays to care for a patient with a history of vagotomy and drainage procedure, the authors thought it worthwhile to review the complications of these surgeries to aid physicians who care for these patients.

Dumping Syndrome

Dumping can occur after vagotomy and drainage procedure. The underlying pathophysiology is not well understood, but the symptoms appear to be related to a food bolus rapidly entering the small intestine, particularly sugars. There are 2 primary forms of dumping syndrome. Early dumping occurs immediately after a meal and includes symptoms of nausea, epigastric discomfort, palpitations, sweating, and rarely, syncope. This is believed to be due to fluid shifts into the small intestine, causing intestinal distention and lower blood volume. Late dumping occurs 1 to 3 hours after a meal and is notable for reactive hypoglycemia in addition to symptoms of early dumping. Dumping syndrome is usually mild, occurs in the early post-operative period, and resolves in the vast majority of patients over time. A small subset of patients experience dumping syndrome beyond their recovery from surgery. Somatostatin analogues, injected prior to a meal, can help alleviate dumping symptoms by decreasing plasma insulin levels and intestinal transit time. For patients with Billroth I or Billroth II anatomy, surgical conversion to Roux-en-Y anatomy can alleviate dumping syndrome.

Diarrhea

Diarrhea can occur after vagotomy, and may be associated with the afore-mentioned dumping syndrome and present as osmotic diarrhea. While the issue has not been studied in depth since the 1970s, studies conducted during this time period demonstrated that cholestyramine, which chelates bile salts, can improve post-vagotomy diarrhea.[36]

Alkaline Reflux

Alkaline reflux is seen in patients with Billroth I and Billroth II anatomy. It can also occur in patients with Roux-en-Y anatomy and a “short” intestinal limb. Alkaline reflux is characterized by postprandial epigastric pain, bile reflux or staining of the stomach seen during endoscopy, and histologic changes of chronic inflammation on gastric biopsy. With significant inflammation, this can also cause gastritis and bleeding. Medical therapy, including PPI, H2 blockers, and bile salt chelators, are usually not beneficial. Persistent symptoms from alkaline reflux can be treated with conversion to a Roux-en-Y gastrojejunostomy, with the intestinal limb measuring 50 to 60 cm to avoid reflux of bile and other intestinal secretions back into the stomach.

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Marginal Ulcer

Classically, patients with a gastro-duodenal or gastro-jejunal anastomosis need to be on PPI medication for the rest of their lives. Failure to do so can result in marginal ulcers due to the acidity of the gastric contents eroding the jejunal mucosa. Smoking and NSAID use are also significant risk factors for marginal ulcers. At times, marginal ulcers can become so significant as to result in perforation or bleeding. Depending on the size of perforation and whether it is an uncontained leak, a patient may need surgery and, depending on the quality of the tissue, complete revision of the anastomosis may be necessary.

Internal Hernia

Internal hernia is primarily a complication of postsurgical patients; usually due to Roux-en-Y anatomy or any gastro-jejunal anastomosis. It is often a late complication, and occurs in 0.5% to 9% of patients.[37] There are typically 2 mesenteric windows created in the Roux-en-Y construction through which the small bowel can herniate, causing an acute small bowel obstruction. Symptoms can be pronounced, such as acute abdominal pain, nausea, and vomiting; however, symptoms can also be episodic and associated with vague abdominal discomfort, distension, or even back pain. Acute pain and internal hernia, however, is a surgical emergency as they are typically closed loop morphology and can rapidly progress to intestinal ischemia and necrosis if not reduced. Reduction can often be achieved laparoscopically, with closure of the mesenteric defect and bowel resection if needed.

SUMMARY

Management of acute upper gastrointestinal bleeding demands a multidisciplinary approach when the patient is unstable or initial endoscopic intervention is unsuccessful. Surgery, once common with well-delineated open approaches, is now uncommon in the United States due to access to and advancement of endoscopy and interventional radiology techniques. As with any surgical intervention, outcomes improve with higher volume (several cases per year), and this is now relatively uncommon to encounter in surgical training. It is unclear whether surgical approaches to PUD or portal hypertension will continue to wane, though data from the past 20 years indicate a need for reconsideration of how surgery can be useful in modern treatment algorithms.

CLINICS CARE POINTS

Bleeding Ulcer:
- Oversewing bleeding ulcers is a way to gain rapid hemostasis.
- Vagotomy and drainage procedures are reserved for patients with refractory PUD and may cause long-term management issues.

Portal Hypertension:
- Several different surgical shunting options exist to address portal hypertension, each with advantages and drawbacks.
- Expertise in the area of surgical shunts is limited in the current era of TIPS, but certain patient populations would benefit from surgical consideration and further research.

Unidentified GI Bleeding:
- On-table enteroscopy is particularly useful to use for occult GI bleeding in the small bowel, helping to isolate culprit lesion and avoid unnecessary intestinal resection.

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- In cases of exsanguinating hemorrhage, a multidisciplinary approach is critical to localize a lesion for hemorrhage control.

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DISCLOSURE

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